J. Plant Production, Mansoura Univ., Vol. 2 (12): 1633 - 1644, 2011

COMPARATIVE STUDY FOR YIELD AND YIELD COMPONENTS OF SOME FLAX LINES WITH THE TWO COMMERCIAL VARIETIES, SAKHA 1 AND SAKHA 2

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ABSTRACT

Two field experiments were conducted at the experimental Farm of Etay El-Baroud, El-Beheira Governorate, Egypt. These trials included forty lines sown in F_6 (in season, 2009/10) and F_7 generation (in seasons, 2010/11). The objective of this investigation is to compare these lines through two generations with the two commercial varieties, Sakha 1 and Sakha 2 for straw, seed, oil yields and their related traits. These materials were evaluated in a randomized complete block design with three replications at the two previous seasons.

Mean squares due to lines were significant for straw weight, seed weight and their components as well as for technological traits, fiber percentage and oil percentage in both seasons. Phenotypic (PCV) and genotypic (GCV) coefficient of variability and broad sense heritability (H%), the slight discrepancy between PCV and GCV for straw weight components (plant height, technical stem length and fiber percentage) and also for seed weight components (oil percentage and 1000-seed weight) were reflected in the high heritability estimates in both seasons for these traits, indicated the possibility of using these yield component traits in selection index technique to achieve further improvement both straw and seed weights by selection for these components.

Concerning mean Performance, out of forty flax lines, five lines, (No. 18, 20, 34, 35, and No. 40) were superior for each seed, oil, straw and fiber yields/fed. Therefore, these five lines may be considered good substitutes for the low yielding ones, Sakha 1 and Sakha 2 in future after evaluation in more locations and years before releasing as a new Egyptian flax cultivar for both straw and seed yields production (as a dual purpose type).

Straw weight per plant was significantly positively correlated with each of plant height, technical stem length, number of capsules per plant and 1000-seed weight in both seasons. Also, plant height exhibited positive correlation with technical stem length in both seasons, indicating that maximization of straw weight per plant may be obtained by selection for these component variables specially plant height and technical stem length. Seed weight per plant, exhibited positive association with oil percentage in both seasons. Whereas, number of capsules per plant was highly positive correlation with 1000-seed weight, indicating the possibility of selection for a genotype as dual purpose type which had high seed weight and high straw components (plant height and technical stem length).

Keywords*:* Flax, comparative study, yield and yield components, correlation.

INTRODUCTION

Flax (*Linum usitatissimum* L.) is one of the oldest crops grown for the production of either fibers (fiber flax type) in Europe or oil (linseed type) in Asian countries. However, in Egypt and other countries flax is cultivated for the production of both fibers and oil. Different varieties are now available for single purpose i.e. fiber or oil and both for fiber and oil (dual purpose). The flax breeding program at Fiber Crops Department, ARC, Egypt, strives to boost straw yield and seed yield as well as technological traits. Therefore, it is necessary to release new promising flax lines that surpass quantitatively and qualitatively the commercial varieties. As suggested by Burton (1952) and Johnson *et al*, (1955), genetic variability together with heritability and genetic advance estimates would provide the best feature of the amount of the gain to be expected from selection. Also, Miller and Rawlings (1967) stated that realizing substantial genetic advance through selection for different yield component, needs sufficient genetic variability. Dudley and Moll (1969) reported that using estimates of heritability and genetic variances in breeding program may increase efficiency through optimization of available resources of the most fruitful parental combinations. The relationships among yield and yield component are complex because the components are greatly influenced by heritable and non-heritable effects as well as their interaction. It is therefore important to estimate correlation coefficient among yield and its attributes. Kumar and Chauhan (1982) found that 1000-seed weight and seeds per capsule may be considered simultaneous characters for selection between flax varieties. Frank and Hollosi (1985) recorded that 1000-seed weight and seeds per capsule have high heritability estimates and were suitable for use as selection principle for seed yield. Mourad (1983) and Abo El-Zahab *et al*, (1994) found that the maximization of seed yield may be obtained via selection for its two main components, number of capsules per plant and 1000-seed weight, while, Abo-Kaied (2003) and Zahana and Abo-Kaied (2007) found that the maximization of straw yield may be obtained by selection for plant height and technical stem length.

The purpose of the present investigation was to evaluate 40 lines of flax derived from four crosses in F6 and F7 generations for phenotypic and genotypic coefficient of variability and heritability for straw, seed yields and their components in addition to technological traits as well as to study the nature of association between key traits for either seed or straw weight besides oil and fiber percentage. These parameters were used in order to compare the different allowed lines of flax that surpass straw, seed yields and their related traits the commercial varieties Sakha 1 and Sakha 2.

MATERIALS AND METHODS

The materials used for the present investigation consisted of 40 lines. The full details of these lines were tested by Zahana and Abo-Kaied, 2007 {Two cycles of selection of F3 and F4 for improving both straw and seed yields by using independent culling levels selection method, resultant forty promising lines belongs to four crosses (The lines from 1:10, belongs to cross (Giza 7 x S.402/3/3/10); 11:20, belongs to cross (Giza 8 x Ariane); 21:30, belongs to cross (S.329/2/23/6 x S.421/43/14/10) and 31:40, belongs to cross (S.402/3/3/10 x Ariane)} as well as the two commercial varieties, Sakha 1 and Sakha 2 as check varieties.

In 2009/10 season, the 40 lines (in F6) in addition to the two commercial varieties (Sakha1 and Sakha2), were grown in Randomized

Complete Block Design (RCBD) with three replicates at Etay El-Baroud Exp.Sta., El-Beheira Governorate. Each block contained 42 entries. A plot size was 3.0 x 2.0 m and contained 10 rows, 20 cm apart and 3 m long. Plant density of 2000 seeds/m2 was used.

In 2010/11 season, 40 lines (in F7) along with the two commercial varieties were grown in the same way as that followed in F6. Plot size, row length and distances between rows were the same as F6 generation. The normal recommended agronomic practices for flax cultivation were applied in the two seasons.

At harvest, data on ten randomly guarded plants were recorded to determine the averages of the individual plant traits. Straw, seed and fiber yields/fed (fed = 4200 m2) were calculated on plot basis. Oil percentage was determined as an average of two random seed samples/plot using Soxhlet apparatus (A.O.A.C. Society, 1995). The following characters were recorded:

I) Straw yield and its related characters:

(1) Straw yield.(ton)/fed, (2) Straw weight (g)/plant., (3) Plant height (cm), (4)Technical stem length (cm), (5) Long fiber yield (ton)/fed and (6) Long fiber percentage (%).

II) Seed yield and its related characters:

(1) Seed yield (ton)/fed, (2) Seed weight (g)/plant, (3) No. of capsules/plant, (4)1000-seed weight (g), (5) Oil yield (ton)/fed and (6) Oil percentage (%).

Biometrical analysis:

Data were subjected to regular analysis of variance of RCBD according to Snedecor and Cochran (1980). The phenotypic (PCV) and genotypic (GCV) coefficient of variation for lines in both seasons were computed as (σph x 100)/ $\bar{x}$ and (σg x 100)/ $\bar{x}$, where σph is the square root of the phenotypic variance of lines, σg is square root of genotypic variance of lines and $\bar{x}$ is the general mean of lines and H% is the heritability in broad sense, ($\sigma 2g/\sigma 2ph$)x100 for the character being evaluated. Phenotypic correlation coefficients among all possible pairs of studied traits were computed by using the data of 40 lines in both seasons.

RESULTS AND DISCUSSION

Variability

Straw yield and its related characters:

Mean square values, variance component estimates, phenotypic (PCV) and genotypic (GCV) coefficient of variability and broad sense heritability (H%) for straw yield, fiber yield, fiber percentage, straw weight/plant and its components of forty flax lines based on data of two successive seasons (S1 and S2) are presented in Table (1). Highly significant differences with a wide variation were detected among entries (40 lines and 2 check varieties, Sakha 1 and Sakha 2) and lines (40 lines) in all traits under study for both seasons except fiber percentage in second season (S2). This indicates that the genetic material used has sufficient variation, revealing the variability existed among these lines, which in turn would increase the chance to select high-yielding potential genotypes for the above mentioned traits. On the other hand, mean squares due to varieties (two check varieties) were non-significant for straw weight/plant and fiber percentage in both seasons as well as straw yield/fed in only the second season, indicating that these two varieties may be considered at the same behavior for these characters. Also, the lines vs. varieties were non-significant for the previous traits and plant height in the second season. Whereas, technical stem length, straw yield/fed and fiber yield/fed exhibited highly significant for the line vs. varieties, indicating that these entries differ in their genetic potential for these characters. Such variability among different flax genotypes in straw weight, plant height and technical stem length was also reported by Momtaz *et al*, (1990) and Zahana and Abo-Kaied (2007).

Estimates of the variance components and heritability, PCV and GCV reached maximum values for straw weight/plant, indicating the possibility to achieve further improvement by selection for this trait. The observed narrow range between PCV and GCV, which gave almost nearly similar values, especially for plant height, technical stem length and fiber percentage in both seasons, reflect the importance of selection for these traits which also gave high heritability estimates. This conclusion may be supported by evidences that yield component traits are genetically controlled. These results indicated the possibility of using these yield component traits in selection index technique with giving more weight for plant height which had high heritability ratios (S1= 99.18 and S2= 95.46%) followed by technical stem length (S1 = 97.40 and S2 = 92.59%). These results are in harmony with that reported by Abo-Kaied *et al*, (2008).

Mean performance for straw yield/fed, fiber yield/fed, fiber percentage, straw weight/plant and its components of forty flax lines plus the two check varieties at two successive seasons (S1 and S2) are presented in Table (2). The line No.10 was superior for each of straw weight/plant (4.68, 4.02 g), plant height (105.6, 106.6 cm) and fiber percentage (18.27, 18.33%) than general mean as well as the two check varieties, Sakha 1 and Sakha 2 at both seasons (S1, S2) respectively. Also, the two lines No. 18 and No 20 exhibited high values for straw yield/fed (4.558, 4.546 and 4.355, 4.044 ton), fiber yield/fed (0.873, 0.873 and 0.819, 0.728 ton) and fiber percentage (19.17, 19.21 and 18.78, 18.02%) at both seasons respectively. Concerning the lines No. 34, 35 and No.40 were superior than the other studied lines as well as the two commercial varieties, Sakha 1 and Sakha 2 for straw yield/fed, fiber yield/fed and fiber percentage in most cases.

In general, the promising lines No. 18 and No. 20, which belongs to the cross (S.329/2/2/3/6 x S.421/43/14/10) and lines No. 34, No. 35 and No. 40, which belongs to the cross (S.402/3/3/10 x Ariane) may be considered good substitutes for the low yielding ones, Sakha 1 and Sakha 2 in future after evaluation in more locations before releasing as a new Egyptian flax cultivars for straw yield and fiber production.

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Seed yield and its related characters:

Mean square values, variance components estimates, phenotypic (PCV) and genotypic (GCV) coefficients of variability and broad sense heritability (H%) for seed yield, oil yield, oil percentage, seed weight/plant and its components of forty flax lines based on data of two successive seasons (S1 and S2) are presented in Table (3). Mean square values showed that entries and lines displayed highly significant differences for all characters under study, indicating that the genetic material used has sufficient variation which might be useful to select for improving seed yield. Mean squares due to varieties (two check varieties) were significant for all characters studied except seed yield/fed and per plant for both seasons as well as No. of capsules/plant and oil yield/fed for only the second season (S2). Also, the lines vs. varieties were significant for most economic characters, indicating that these entries differ in their genetic potential for these characters. Such variability among different flax genotypes in oil and seed characters was also reported by Momtaz *et al*, (1990), Zahana and Abo-Kaied (2007) and Abo-Kaied *et al*, (2008).

Regarding estimates of the variance components, heritability, phenotypic and genotypic coefficient of variability exhibited high values for both seed weight/plant and No. of capsules/plant in both seasons. These results indicated that, the high range of variability might be useful in selecting lines characterized by high-yielding potential for both seed weight and No. capsules/plant in this material. On the other hand, the low or moderate of PCV and GCV values in addition to the slight discrepancy between PCV and GCV values for oil percentage and 1000-seed weight were reflected in the high heritability estimates in both seasons for these traits. Such results support the view that the expected gain from selection would be valid and that a substantial improvement for this variable could be expected by selecting superior genotypes. Similar finding regarding high coefficient of variation of 1000-seed weight and No. of capsules/plant with high heritability estimates have reported by Frank and Hollosi (1985), Abo El-Zahab *et al*, (1994), Zahana and Abo-Kaied (2007) and Abo-Kaied *et al*, (2008).

Table (4) shows the mean performance of seed yield, oil yield, oil percentage, seed weight/plant and its components for forty flax lines based on data of two successive seasons (S1 and S2). Line No. 10 recorded highest values for each of seed weight/plant (1.00, 0.98 g), 1000-seed weight (10.60, 10.61 g), seed yield/fed (0.772, 0.739 ton), oil yield/fed (0.332, 0.311 ton) and oil percentage (43.00, 42.07%) in both seasons, respectively than the other lines as well as the two check varieties. Also, lines No. 11 for both 1000-seed weight, seed yield/fed and oil yield/fed; No.18 and No.20 for each at 1000-seed weight, seed yield/fed, oil yield/fed and oil percentage; No.31 for each number of capsules/plant, seed yield/fed and oil yield/fed; No.34 for both oil yield/fed and oil percentage; No.35 for each 1000-seed weight, seed yield/fed, oil yield/fed and oil percentage and finally No.40 for all characters under study.

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Out of these previous lines which showed highest mean performance for seed yield and its components than the other studied lines as well as the two check varieties, only five lines (No. 18, 20, 34, 35, and No. 40) were superior for each seed, oil, straw and fiber yields/fed. Therefore, these five lines should be recommended as commercial varieties (as dual purpose type) and/or to be incorporated as breeding stocks in breeding program aiming at producing high yielding flax lines for both seed and straw yields.

Table 4. Mean values for Seed yield, oil yield, oil percentage, seed weight/plant and its components of forty flax lines based on data of two successive seasons (S1= 2009/10 and S2= 2010/11).

Line	Seed weight/planr (g)		No.of capsules/plant		1000-seed weight (g)		Seed yield (ton)/fed		Oil yield (ton)/fed.		Oil percentage (%)	
No.	F6	F7	F6	F7	F6	F7	F6	F7	F6	F7	F6	F7
1	0.71	0.68	11.38	10.06	9.93	9.80	0.624	0.613	0.259	0.252	41.55	41.13
2	0.71	0.67	10.03	9.96	9.43	8.53	0.566	0.548	0.221	0.217	39.15	39.56
3	0.88	0.82	10.40	10.06	10.56	10.51	0.555	0.558	0.226	0.227	40.72	40.79
4	0.56	0.63	7.16	8.55	10.14	9.73	0.607	0.644	0.225	0.246	37.05	38.25
5	0.94	0.93	12.74	10.93	10.96	10.93	0.610	0.602	0.250	0.247	41.00	41.00
6	0.85	0.81	11.09	10.89	9.05	8.91	0.540	0.497	0.210	0.197	38.94	39.64
7	0.88	0.91	11.76	13.97	10.46	10.37	0.611	0.593	0.249	0.239	40.74	40.23
8	0.95	0.83	12.83	12.97	10.10	9.60	0.673	0.698	0.267	0.275	39.62	39.39
9	0.63	0.72	8.84	9.55	10.50	10.83	0.681	0.681	0.267	0.261	39.27	38.28
10	1.00	0.98	12.34	14.37	10.60	10.61	0.772	0.739	0.332	0.311	43.00	42.07
11	0.60	0.75	6.59	11.92	12.06	10.27	0.717	0.738	0.298	0.309	41.60	41.94
12	0.75	0.87	8.66	13.33	10.22	9.98	0.786	0.768	0.333	0.322	42.33	42.00
13	0.55	0.59	6.27	7.90	10.99	10.66	0.641	0.629	0.255	0.256	39.80	40.74
14	0.59	0.59	7.25	8.73	11.26	10.79	0.594	0.555	0.242	0.227	40.83	40.90
15	1.06	0.89	12.28	12.90	10.15	10.26	0.644	0.670	0.255	0.271	39.62	40.39
16	0.86	0.76	12.80	13.20	9.09	9.16	0.577	0.554	0.222	0.210	38.50	37.94
17	0.61	0.76	8.36	10.93	10.32	9.85	0.611	0.615	0.240	0.235	39.33	38.28
18	0.96	1.10	11.24	19.78	11.19	10.62	0.761	0.774	0.326	0.328	42.83	42.39
19	0.62	0.63	8.38	12.15	9.72	8.96	0.644	0.627	0.272	0.260	42.24	41.50
20	0.90	0.91	9.83	14.14	10.58	10.54	0.756	0.743	0.326	0.318	43.11	42.83
21	1.04	0.85	11.17	11.28	10.51	10.27	0.655	0.648	0.257	0.259	39.29	40.07
22	0.88	0.92	9.59	12.50	12.34	10.05	0.715	0.642	0.291	0.263	40.67	41.06
23	0.99	0.89	10.31	11.06	10.62	9.85	0.656	0.611	0.266	0.249	40.61	40.78
24	0.94	0.82	10.57	9.90	10.37	10.33	0.702	0.644	0.287	0.269	40.90	41.79
25	1.06	0.88	10.99	10.74	11.51	10.83	0.661	0.616	0.270	0.252	40.93	40.86
26	0.75	0.73	7.92	9.40	11.23	10.11	0.616	0.583	0.264	0.245	42.84	42.11
27	0.88	0.86	9.54	10.90	11.92	11.03	0.681	0.670	0.284	0.273	41.73	40.75
28	0.59	0.75	6.90	9.76	11.08	10.65	0.681	0.670	0.279	0.275	40.96	41.01
29	0.86	0.90	10.93	12.54	10.70	10.66	0.596	0.598	0.247	0.242	41.45	40.52
30	0.60	0.86	9.44	12.57	7.60	10.16	0.641	0.678	0.276	0.289	43.11	42.66
31	0.74	0.74	11.67	16.63	7.81	7.97	0.751	0.773	0.314	0.320	41.88	41.46
32	0.75	0.84	11.70	18.32	7.45	8.28	0.636	0.665	0.263	0.275	41.36	41.39
33	0.79	0.85	11.71	18.41	7.85	7.94	0.683	0.723	0.274	0.294	40.06	40.66
34	0.74	0.83	11.20	12.45	7.78	10.17	0.783	0.768	0.336	0.330	42.97	43.03
35	0.94	0.93	11.06	15.10	11.34	10.47	0.789	0.786	0.334	0.333	42.39	42.33
36	0.86	0.89	13.05	17.50	9.18	8.68	0.707	0.727	0.272	0.278	38.44	38.27
37	0.66	0.75	10.02	17.25	7.53	7.58	0.694	0.702	0.276	0.287	39.78	40.89
38	0.64	0.84	10.24	19.13	7.76	7.89	0.702	0.747	0.283	0.306	40.23	40.93
39	0.88	0.79	11.24	16.31	8.80	9.01	0.669	0.669	0.272	0.274	40.73	41.01
40	1.09	1.05	13.26	16.85	11.26	11.20	0.775	0.765	0.332	0.325	42.85	42.47
Mean	**0.80**	**0.82**	**10.32**	**12.87**	**10.05**	**9.85**	**0.669**	**0.663**	**0.274**	**0.271**	**40.86**	**40.83**
LSD 0.05	**0.10**	**0.13**	**1.00**	**3.08**	**0.49**	**0.39**	**0.046**	**0.027**	**0.019**	**0.014**	**0.88**	**0.86**
Sakha1	0.72	0.77	11.32	12.36	8.58	8.70	0.616	0.626	0.247	0.251	40.17	40.17
Sakha2	0.80	0.85	12.87	12.78	9.49	9.58	0.652	0.641	0.269	0.265	41.32	41.32

For explanation see Table 3.

Correlation studies:

Phenotypic correlation coefficients among straw, seed weight per plant and their components as well as some technological characters (fiber percentage and oil percentage) of forty flax lines based on data of two successive seasons (S1 and S2) are presented in Table (5). Straw weight/plant was highly significant positive correlated with each of plant height, technical stem length, No. of capsules/plant and 1000-seed weight in both seasons (S1 and S2). Also, plant height exhibited positive correlation with technical stem length in both seasons, indicating that maximization of straw weight/plant may be obtained by selection for these component variables specially plant height and technical stem length. These results are in harmony with that reported by Abo El-Zahab *et al*, (1994) and Abo-kaied *et al*, (2006). Seed weight per plant, exhibited positive association with oil percentage in both seasons as well as was positive correlation with each of No. of capsules/plant, 1000-seed weight, in only second season (S2). Whereas, number of capsules/plant was highly positive correlated with 1000-seed weight, indicating the possibility of selection for a genotype as dual purpose type which had high seed weight and high straw components (plant height and technical stem length). These results are in agreement with those obtained by Abo El-Zahab *et al*, (1994) and Abo-kaied *et al*, (2006).

Table5. Phenotypic correlation coefficient among straw, seed weight/plant and their components as well as some technological traits of forty flax lines based on data of two successive seasons (2009/10 and 2010/11).

Characters		1	2	3	4	5	6	7
1- Straw weight / plant (g)								
2- Plant height (cm)	S1	0.736**						
	S2	0.629**						
3- Technical stem length (cm)	S1	0.521**	0.918**					
	S2	0.470**	0.910**					
4- Seed weight/ plant (cm)	S1	0.311	0.189	0.125				
	S2	0.446**	0.524**	0.420**				
5- No. of capsules / plant	S1	0.435**	0.014	-0.114	0.099			
	S2	0.588**	0.262	0.174	0.483**			
6- 1000-seed weight (g)	S1	0.638**	0.355*	0.135	0.068	0.736**		
	S2	0616**	0.752**	0.659**	0.485**	0.558**		
7- Fiber percentage (%)	S1	-0.396*	-0.543**	-0.345*	-0.133	0.277	-0.296	
	S2	-0.161	-0.446	-0.363*	0.098	0.266	-0.503	
8- Oil percentage (%)	S1	0.286	0.143	0.093	0.548**	0.150	0.021	0.131
	S2	0.265	0.263	0.216	0.593**	0.348*	0.233	0.230

***,**=Indicate significance at the 0.05 and 0.01 levels of probability, respectively.**
S1= 2009/10 S2= 2010/11

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دراسة مقارنة للمحصول ومكوناته لبعض سلالات الكتان مع الصنفين التجاريين سخا١ وسخا٢

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استخدم في هذه الدراسة٤٠ سلالة من الكتان زرعت في موسمين متتالية (٢٠٠٩ / ٢٠١٠"جيل سادس"، ٢٠١٠ /٢٠١١ "جيل سابع") مع الصنفين التجاريين سخا١ وسخا٢ بمحطة البحوث الزراعية بايتاي البارود– م البحيرة، وذلك لمقارنة محصول كل من القش والبذور والزيت والصفات المرتبطة بهم لهذه السلالات مع الصنفين التجاريين سخا ١، سخا ٢. وكان التصميم المستخدم هو قطاعات كاملة العشوائية ذات الثلاث مكررات

تشير النتائج إلى معنوية التباين الخاص بالسلالات لكل من محصول القش والبذور ومكوناتهما وكذلك كل الصفات التكنولوجية المدروسة (النسبة المئوية للألياف والنسبة المئوية للزيت) في الموسمين. كما تشير النتائج إلى تقارب قيم تقديرات معاملي الاختلاف الظاهري والوراثي لمكوني محصول القش (الطول الكلي والطول الفعال) بالإضافة إلي النسبة المئوية للألياف وكذلك بالنسبة لمحصول البذور (وزن الألف بذرة والنسبة المئوية للزيت) مع درجة توريث عالية لتلك الصفات السابقة لكلا الموسمين. وذلك يشير إلي إمكانية استخدام مكونات المحصول سالفة الذكر كدلائل انتخابية لتحسين محصولي القش والبذور.

أشارت نتائج متوسطات المحصول إلي أن خمسة سلالات (رقم١٨، ٢٠، ٣٤، ٣٥ ،٤٠) تفوقت في محصول القش والبذور والألياف والزيت للفدان . لذلك هذه السلالات الخمس يمكن أن تحل محل الصنفين التجاريين (سخا١، وسخا٢) المنخفضين عنها في المحصول، وذلك بعد تقييم تلك السلالات في عدد أكبر من المواقع والسنوات قبل إطلاقها كأصناف كتان مصرية تزرع لكل من محصولي القش والبذور (كأصناف ثنائية الغرض).

أشارت نتائج الارتباط الظاهري أن وزن القش للنبات أظهر ارتباط موجب ومعنوي مع كل من الطول الكلي والطول الفعال وعدد الكبسولات للنبات ووزن الألف بذرة في كلا الموسمين. كذلك هناك ارتباط موجب ومعنوي بين الطول الكلي والطول الفعال في كلا الموسمين، وهذا يشير إلي إمكانية تحسين محصول القش للنبات بالانتخاب لتلك الصفات خاصة الطول الكلي والطول الفعال. كذلك كان هناك ارتباط موجب ومعنوي بين وزن البذور للنبات والنسبة المئوية للزيت لكلا الموسمين. كذلك عدد الكبسولات للنبات ووزن الألف بذرة كان بينهما ارتباط موجب وعالي المعنوية. مما يدل علي إمكانية انتخاب تراكيب وراثية ثنائية الغرض تتميز بالمحصول العالي من البذور بالإضافة إلى تميزها في الطول الكلي والطول الفعال وهما أهم مكونين من مكونات محصول القش.

قام بتحكيم البحث

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Table 1. Mean square values, variance component estimates, phenotypic (PCV) and genotypic (GCV) coefficients of variability and broad sense heritability (H%) for Straw yield, fiber yield, fiber percentage, straw weight/plant and its components of forty flax lines based on data of two successive seasons(2009/10 and 2010/11).

Characters		*S.O.V.*					Variance components and some genetic parameters					
		Entries (E)(41)#	Lines (F)(39) #	Varieties (V)(1) #	L. vs. V. (1)	Error (84) #	σ^2ph	σ^2g	σ^2e	PCV%	GCV%	H%
Straw yield, fiber yield, fiber percentage, straw weight/plant and its components												
Straw weight/plant (g)	**S1**	2.405 **	2.525 **	0.082 ns	0.082 ns	0.064	0.842	0.820	0.064	32.952	32.530	97.45
	S2	1.47 **	1.541 **	0.045 ns	0.152 ns	0.061	0.514	0.493	0.061	26.610	26.075	96.02
Plant height (cm)	**S1**	525.929 **	536.225 **	516.896 **	133.423 **	4.398	178.742	177.276	4.398	13.760	13.703	99.18
	S2	281.422 **	292.32 **	131.695 **	6.142 ns	13.259	97.440	93.020	13.259	9.936	9.708	95.46
Technical stem length (cm)	**S1**	317.237 **	313.597 **	223.993 **	552.446 **	8.143	104.532	101.818	8.143	13.463	13.287	97.40
	S2	242.593 **	225.772 **	404.917 **	736.291 **	16.724	75.257	69.683	16.724	10.731	10.326	92.59
Straw yield (ton)/fed	**S1**	0.652 **	0.636 **	0.68 **	1.25 **	0.075	0.212	0.187	0.075	11.452	10.755	88.20
	S2	0.874 **	0.868 **	0.29 ns	1.688 **	0.012	0.289	0.285	0.012	13.513	13.419	98.62
Fiber yield (ton)/fed	**S1**	0.038 **	0.039 **	0.023 **	0.041 **	0.002	0.013	0.012	0.002	16.947	16.418	93.85
	S2	0.040 **	0.041 **	0.010 **	0.050 **	0.001	0.014	0.013	0.001	17.698	17.582	98.69
Fiber percentage (%)	**S1**	4.63 **	4.859 **	0.220 ns	0.132 ns	0.113	1.620	1.582	0.113	7.680	7.590	97.67
	S2	3.977	4.176	0.150 ns	0.028 ns	0.218	1.392	1.319	0.218	7.141	6.952	94.78

***,** = Indicate significance at the 0.05 and 0.01 levels of probability, respectively.**
 # =Values designated the corresponding degrees of freedom.
σ^2ph, σ^2g, σ^2e : Phenotypic, genotypic, plot error variances, respectively.
S1= season 2009/10 S2= season 2010/11

Table 2. Mean values for straw yield/fed, straw weight/plant and its components of forty flax lines based on data of two successive seasons (S1= 2009/10 and S2= 2010/11).

Line No.	Straw weight/plant (g)		Plant height (cm)		Technical stem length (cm)		Straw yield (ton)/fed		Fiber yield (ton)/fed		Fiber percentage (%)	
	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2
1	1.48	1.40	83.90	91.20	68.40	74.80	4.227	4.182	0.658	0.661	15.56	15.80
2	1.93	1.64	85.90	92.25	68.50	73.05	3.719	3.609	0.601	0.604	16.18	16.73
3	3.12	2.72	90.70	91.85	69.60	71.15	3.781	3.397	0.568	0.510	15.05	15.02
4	2.11	1.90	88.10	91.10	72.20	76.30	3.535	3.339	0.582	0.510	16.46	15.26
5	3.00	3.10	86.50	92.32	63.00	71.82	3.370	3.332	0.492	0.513	14.60	15.40
6	2.15	2.42	84.40	91.83	61.90	66.93	3.665	3.315	0.596	0.532	16.27	16.07
7	2.77	2.43	98.10	94.68	77.50	76.18	3.932	4.173	0.618	0.627	15.73	15.03
8	3.39	2.95	104.50	101.50	81.00	81.60	4.051	4.191	0.608	0.696	15.00	16.63
9	1.76	1.64	82.90	90.83	66.40	74.63	3.780	3.744	0.623	0.577	16.48	15.43
10	4.68	4.02	105.60	106.60	80.60	85.70	3.964	3.509	0.723	0.643	18.27	18.33
11	1.91	2.01	92.20	93.65	76.60	79.15	3.995	3.808	0.643	0.603	16.06	15.82
12	2.12	2.48	84.30	103.62	70.50	80.54	3.993	3.174	0.757	0.587	19.00	18.51
13	1.78	1.83	91.90	93.21	79.00	79.81	3.870	3.865	0.611	0.620	15.79	16.06
14	1.83	1.78	99.30	104.10	83.60	87.30	3.442	3.340	0.555	0.550	16.12	16.47
15	2.25	2.56	86.30	92.73	63.60	73.42	3.755	3.659	0.638	0.614	17.00	16.79
16	2.82	3.31	90.40	93.82	63.90	72.92	3.531	3.355	0.559	0.530	15.83	15.80
17	1.83	2.21	92.70	93.92	76.20	77.17	3.805	3.908	0.593	0.584	15.60	14.95
18	3.19	2.83	97.60	101.60	76.00	82.00	4.558	4.546	0.873	0.873	19.17	19.21
19	1.34	1.65	83.10	90.12	67.80	74.72	3.573	3.186	0.602	0.532	16.85	16.70
20	2.29	2.26	91.20	100.05	70.60	82.35	4.355	4.044	0.819	0.728	18.78	18.02
21	3.01	2.75	91.40	93.22	68.20	75.50	3.432	3.620	0.564	0.570	16.42	15.79
22	2.15	2.43	92.50	95.60	76.30	80.54	3.848	3.749	0.614	0.583	15.97	15.53
23	2.81	2.84	87.00	90.28	69.30	74.85	4.115	4.507	0.670	0.722	16.28	16.03
24	2.41	2.48	82.70	88.50	58.40	70.07	4.162	4.333	0.652	0.646	15.68	14.89
25	2.75	2.66	91.70	91.94	76.50	77.16	3.565	3.781	0.563	0.610	15.78	16.13
26	2.53	2.45	90.30	92.81	70.90	76.76	3.439	3.339	0.512	0.533	14.92	15.96
27	2.88	2.99	86.90	89.68	67.10	72.38	4.047	4.236	0.658	0.689	16.27	16.28
28	1.40	1.64	81.50	85.62	66.70	71.47	3.886	4.171	0.632	0.672	16.29	16.11
29	2.84	2.67	114.30	94.13	95.20	91.43	3.382	3.557	0.527	0.578	15.59	16.24
30	3.00	3.28	95.85	109.40	71.20	83.40	3.683	3.603	0.705	0.640	19.12	17.81
31	4.18	3.62	124.10	107.40	88.00	86.70	4.550	4.775	0.743	0.777	16.33	16.28
32	4.48	4.01	102.70	103.75	76.75	79.45	4.825	4.602	0.797	0.771	16.53	16.76
33	2.77	2.98	114.50	113.65	87.80	91.30	4.495	4.657	0.727	0.742	16.18	15.94
34	5.02	3.90	131.40	109.40	92.25	87.25	4.935	4.890	0.951	0.921	19.27	18.83
35	3.57	3.63	108.90	111.45	90.00	92.35	4.831	4.915	0.905	0.928	18.74	18.89
36	3.77	3.51	113.70	115.45	92.50	95.05	4.280	4.349	0.689	0.732	16.09	16.85
37	3.26	2.97	120.30	120.70	94.00	100.30	4.459	4.314	0.734	0.719	16.46	16.66
38	2.78	2.55	114.80	113.20	91.10	95.00	4.676	4.577	0.758	0.760	16.22	16.61
39	4.25	3.70	124.00	124.20	94.30	103.35	4.341	4.619	0.707	0.755	16.29	16.35
40	3.83	3.61	98.40	112.60	74.30	87.90	5.009	4.941	0.935	0.938	18.66	18.99
Mean	**2.78**	**2.69**	**97.16**	**99.35**	**75.94**	**80.84**	**4.021**	**3.980**	**0.669**	**0.660**	**16.57**	**16.52**
LSD 0.05	**0.41**	**0.40**	**3.39**	**5.89**	**4.61**	**6.61**	**0.443**	**0.177**	**0.079**	**0.037**	**0.54**	**0.75**
Sakha1	2.78	2.62	101.61	103.00	72.22	77.71	3.890	3.656	0.646	0.607	16.61	16.61
Sakha2	2.55	2.44	83.05	93.63	60.00	61.28	3.217	3.217	0.522	0.524	16.23	16.29

The liness from 1:10 = belong to cross (Giza 7 x S.402/3/3/10), 11:20=belong to cross (Giza 8 x Ariane) ,

21:30=belong to cross (S.329/2/23/6 x S.421/43/14/10) and 31:40=belong to cross (S.402/3/3/10 x Ariane).

Table 3. Mean square values, variance component estimates, phenotypic (PCV) and genotypic (GCV) coefficients of variability and broad sense heritability (H%) for Seed yield, oil yield, oil percentage, seed weight/plant and its components of forty flax lines based on data of two successive seasons(2009/10 and 2010/11).

Characters		*S.O.V.*					Variance components and some genetic parameters					
		Entries (E)(41)#	Lines (F) (39) #	Varieties (V)(1) #	L. vs. V. (1)	Error (84) #	σ^2ph	σ^2g	σ^2e	PCV%	GCV%	H%
Seed yield, oil yield, oil percentage, seed weight/plant and its components												
Seed weight /plant (g)	**S1**	0.072 **	0.075 **	0.010 ns	0.012 ns	0.003	0.025	0.024	0.003	19.645	19.186	95.38
	S2	0.037 **	0.039 **	0.009 ns	0.001ns	0.007	0.013	0.011	0.007	13.894	12.653	82.92
No. of capsules/plan	**S1**	10.656 **	10.649 **	3.593 **	18.024 **	0.384	3.550	3.422	0.384	18.257	17.925	96.40
	S2	28.850 **	30.310 **	0.253 ns	0.519 ns	3.635	10.103	8.892	3.635	24.694	23.167	88.09
1000-seed weight	**S1**	5.407 **	5.502 **	1.233 **	5.889 **	0.091	1.834	1.804	0.091	13.477	13.365	98.34
	S2	2.851 **	2.893 **	1.153 **	2.900 **	0.057	0.964	0.945	0.057	9.969	9.870	98.02
Seed yield (ton)/fed	**S1**	0.013 **	0.014 **	0.002 ns	0.007 **	0.001	0.005	0.004	0.001	10.106	9.807	94.18
	S1	0.016 **	0.017 **	0.001 ns	0.005 *	0.000	0.006	0.005	0.000	11.231	11.135	98.30
Oil yield (ton)/fed	**S2**	0.003 **	0.004 **	0.001 *	0.001 **	0.000	0.001	0.001	0.000	12.524	12.270	95.97
	S2	0.004 **	0.004 **	0.001 ns	0.001 *	0.000	0.001	0.001	0.000	13.083	12.959	98.11
Oil percentage (%)	**S1**	6.426 **	6.702 **	1.995 *	0.076 ns	0.298	2.234	2.135	0.298	3.658	3.576	95.56
	S2	5.071 **	5.279 **	1.995 *	0.043 ns	0.283	1.760	1.666	0.283	3.249	3.161	94.65

For explanation see Table 1.